Nota lepid. 23 (1): 64–70; 01.IV.2000 ISSN 0342–7536

New data on the ecology of *Thecla betulae* in the northeast of the Iberian Peninsula (Lycaenidae)

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Summary. Observations of 3rd and 4th instar larvae of *Thecla betulae* associated with two ant species, *Formica rufibarbis* and *Lasius grandis*, are reported for the first time under field conditions. New data on secondary host plants other than blackthorn (*Prunus spinosa*) are also given for two populations from the northeast of the Iberian Peninsula.

Zusammenfassung. Vergesellschaftungen der Raupen (3. und 4. Larvalstadium) von *Thecla betulae* mit zwei Ameisenarten, *Formica rufibarbis* und *Lasius grandis*, werden erstmalig aus dem Freiland beschrieben. Ferner werden für zwei Populationen aus dem Nordosten der Iberischen Halbinsel neue Beobachtungen zu sekundären Wirtspflanzen neben der Hauptnahrungspflanze der Raupen (Schlehe, *Prunus spinosa*) mitgeteilt.

Résumé. Des observations relatives aux 3ième et 4ième état larvaire de *Thecla betulae* en association avec deux espèces de fourmis, *Formica rufibarbis* et *Lasius grandis*, sont rapportées pour la première fois en conditions naturelles. De nouvelles données concernant des plantes-hôtes secondaires autres que le prunellier (*Prunus spinosa*) sont également présentées pour deux populations en provenance du nord-est de la péninsule ibérique.

Key words: Lycaenidae, *Thecla betulae*, myrmecophily, *Formica rufibarbis*, *Lasius grandis*, host plants, *Prunus domestica*, Catalonia, Iberian Peninsula.

Thecla betulae (Linnaeus, 1758) is an Eurasian lycaenid occurring in most of Europe and through Asia to Korea (Tolman & Lewington, 1997). In Spain it is restricted to the northern part of the country, from Galicia to Catalonia. The presence of isolated populations in Ávila and north Extremadura has been questioned recently by García-Villanueva *et al.* (1997) and, therefore, the southernmost Spanish strongholds are probably found in Catalonia, a region where its distribution is fairly well known (Viader, 1994; Stefanescu, 1997).

Most ecological knowledge on European populations of this species comes from extensive studies carried out by J. A. Thomas

in the early 70's (Thomas, 1974). Though additional data have been gathered by other authors since then (e.g. Ebert & Rennwald, 1991), the published information from southern European countries is almost inexistent.

In this note some new data on the ecology of *T. betulae* in the northeast of the Iberian Peninsula are given, in particular concerning its myrmecophilous behaviour and its feeding habits.

Myrmecophily in *T. betulae*

Many lycaenids associate with ants during their immature stages, though the degree of myrmecophily varies among the species (Fiedler, 1991a). In the Western Palaearctic region, however, the vast majority (more than 75%) of lycaenids are myrmecophilous, at least towards the end of the larval stage (Fiedler, 1991b).

The strength of ant-associations is related to the presence and secretory activity of so-called myrmecophilous organs: multiple minute pore cupola organs (PCOs), a dorsal nectar organ (DNO) and paired tentacle organs (TOs) (cf. Fiedler *et al.*, 1996). Both DNO and TOs are absent in so-called myrmecoxenous species (i.e., those not attended by ants in nature) and, conversely, re-inforce and stabilize the associations between larvae and ants in truly myrmecophilous lycaenids (Fiedler, 1991a; Fiedler *et al.*, 1996). PCOs occur in both lycaenid larvae and pupae of all studied European species (e.g. Malicky, 1969). PCOs produce secretions highly attractive to ants (possibly amino acids and pheromones; Fiedler *et al.*, 1996), though differences in the function of these organs have been found (Fiedler, 1991a).

Within the tribe Theclini, species in the predominantly Holarctic subtribe Thecliti (cf. Eliot, 1992) show reduced myrmecophilous organs. TOs are entirely missing and the presence of a fully functional DNO has not yet been confirmed without doubt for any Thecliti species (Fiedler, 1991a). In *Thecla betulae* only PCOs are present (Malicky, 1969; Fiedler, 1991b), and hence just a weakly myrmecophilous relationship is to be expected.

In fact, no records of ant-associations of *T. betulae* larvae under field conditions appear to have ever been published. In his thorough review, Fiedler (1991a) scored *T. betulae* as a weakly myrmecophilous species because, as indicated by Malicky (1969), some

old records vaguely stated that occasionally ant-associations seem to occur. However, intensive field work in England gave no additional evidence of this association (Thomas, 1974, 1975). On the other hand, fully grown larvae are known to be very attractive to a variety of ants in captivity (Taylor, 1915; Malicky, 1969; Fiedler, pers. comm.), and pupal ant-associations in the wild with *Lasius niger* or related taxa have already been described (Thomas, 1986; Thomas & Emmet, 1989).

In May 1998 and 1999, I was able to make some interesting observations of ant-associations of 3rd and 4th instar larvae of *T. betulae* under field conditions for the first time. On 29 April 1998 three larvae in their 3rd instar were found resting on the underside of leaves of two blackthorn bushes (*Prunus spinosa)* at Can Liro (Sant Pere de Vilamajor, Barcelona province, 41°41'16 N 2°23'07 E, 310 m), in NE Spain. Both blackthorns were ca. 1.5 m tall and grew in a hedgerow between cultivated fields. Egg-laying by *T. betulae* had been recorded on both bushes the previous September and October and seems to occur regularly every season (pers. obs.).

T. betulae larvae were monitored until they left for pupation by the end of May. On 16 May a last instar larva was seen attended by a worker of *Formica rufibarbis*. On 27 May another full-grown larva was found attended by two *Lasius grandis* workers (Fig. 1). In the first case, the association lasted only for a short time (approx. 1–2 min.), but on the second occasion *L. grandis* workers attended the larva for at least 15 min. and showed no signs of disturbance while the pictures were taken.

On 11 and 21 May 1999 a 3rd and a 4th instar larvae were found on another blackthorn in the same hedgerow. Both larvae were monitored almost daily until they left for pupation on 28 May and 2 June, respectively. The first larva was found attended by one or two *L. grandis* ants on four out of eight occasions while in the 3rd instar, and on eight out of ten occasions while in the 4th instar. The second larva was seen attended by *L. grandis* two out of ten times, but in one of these there were four mutualistic ants.

Thomas & Emmet (1989) suggested that the lack of field observations of ant-associations with *T. betulae* larvae may be a consequence of their habitat. In the temperate-zone woodlands the number of ants foraging on bushes and lower trees is limited and thus

Fig. 1. Fourth instar larva of *Thecla betulae* tended by two *Lasius grandis* workers (Photograph: M. Miralles).

the probability of encounters between ants and *T. betulae* caterpillars is much reduced (see also Malicky, 1969 and Fiedler, 1991a for a similar but more general reasoning). In the area where the forementioned observations were made, however, blackthorns and a nearby peach tree *Prunus persica* were intensively visited by *Lasius grandis* and *Formica rufibarbis* throughout April–May and June (but not later on in the season), attracted by aphids that concentrated by that time on the underside of some young leaves and possibly also by extrafloral nectaries occurring on these plants (cf. Tilman, 1978). My own data seem to indicate that these associations may be quite common, though full-grown larvae have been found several times at the same hedgerow and also at nearby places without mutualistic ants.

Host plant use

Most European records mention blackthorn *Prunus spinosa* as the most usual food plant of *T. betulae* (e.g. Tolman & Lewington, 1997) and in Spain this was the only species recorded so far (Munguira *et al.*, 1997).

In 1998, however, one larva and several eggs were found on plum *Prunus domestica* at two different sites. On 23 April a 3rd instar larva was found on the underside of a leaf in Can Riera de Vilardell, an agricultural area surrounded by evergreen oak forest near the village of Sant Celoni, Barcelona province (41°41' N 2°32' E, 250 m). In addition, during the winter, several eggs were found on various plums growing in the vicinity of Can Liro.

Finally, on 7th October 1995, also at Can Liro, a female was seen in oviposition behaviour on a peach tree *Prunus persica*. She alighted on the tree and immediately started walking on a twig, tapping with her forelegs and antennae. However, no egg was finally laid. Although no actual oviposition record was obtained, the distinctive behaviour shown by this female seems indicative that peach trees may be sometimes used as a secondary host plant in this population.

These observations confirm that several woody plant species other than blackthorn are used as host plants by *T. betulae* in Europe. In Germany, for example, *Prunus domestica* and other related shrubs and trees of the family Rosaceae (*Prunus insititia*,

P. avium, *P. padus*, *Crataegus monogyna* and *Chaenomeles japonica*) had already been cited as food plants (Ebert & Rennwald, 1991; K. Fiedler, unpubl. data). In Britain, *P. insititia* had also been recorded as a food plant in the wild (Thomas & Emmet, 1989), and a couple of other Rosaceae species (mostly in *Prunus* and related genera) are documented as host plants of Eastern Asian populations (e.g. Dantchenko *et al.*, 1995).

Moreover, there is at least one confirmed record of oviposition on *Betula pendula* (Betulaceae) from Germany (Ebert & Rennwald, 1991), that indicates that even plants not belonging to the Rosaceae can be occasionally selected by ovipositing females. This record, together with others obtained from the Russian and Japanese literature (eggs and/or larvae found on several plants belonging to the Betulaceae, Caprifoliaceae, Corylaceae, Grossulariaceae and Salicaceae: Lukhtanov & Lukhtanov, 1994; Korshunov & Gorbunov, 1995) led Fiedler (1991a) to categorize *T. betulae* as a moderately polyphagous species.

Acknowledgements

Prof. Dr. K. Fiedler kindly read a first MS and provided much information and valuable comments to this paper. My wife, Marta Miralles, took the excellent picture of the *Thecla betulae* larva attended by *Lasius grandis* workers and also found a 3rd instar larva feeding on *Prunus domestica*. Xavier Espadaler (Universitat Autònoma de Barcelona) identified *Formica rufibarbis* and *Lasius grandis* ants.

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